PHYS 1112 GENERAL PHYSICS I WITH CALCULUS
SUMMER 2018

(4 weeks; Tentative dates: 19 Jun – 13 Jul 2018)

A. Course Description

PHYS 1112 employs a calculus-based approach. Key topics include:

- Motions and Newton's laws
- Work and energy
- Conservation of energy and momentum
- Rotation
- Rigid body
- Simple harmonic and damped oscillations
- Forced oscillations
- Standing waves and sound waves
- Kinetic theory
- The laws of thermodynamics

Credit Points: 3
Pre-requisite: Senior high school level or above in physics and math with single-variable calculus

B. Intended Learning Outcomes (ILO)

On successful completion of this course, students are expected to be able to:

1. Use Newton's laws of motion to solve simple dynamics problems.
2. Use the principles of conservation of energy and momentum to solve simple dynamics problems and problems with rotational motion, and explain common physical phenomena.
3. Explain physical phenomena unique to waves such as superposition, interference, formulation of standing waves, resonance, beats and Doppler effects.
4. Use kinetic theory to explain the properties of gases.
5. Use the first and second laws of thermodynamics to solve problems involving ideal gases.
6. Use scientific language to explain phenomena in the physical world.
7. Use calculus to analyze and solve physical problems.

C. Textbook

Textbook: University Physics by Young & Freedman
Online assignment system: Mastering Physics http://masteringphysics.com
Experimental demonstrations: http://teaching.phys.ust.hk/demo

D. Teaching and Learning Activities (total 4 weeks)

	Lecture	Tutorial	Independent study
Hours per week	9	6	12

E. Assessment

	Online assignment	Tests	Final exam
Weighting	10%	40%	50%

F. Course Schedule

Week	Lecture (1.5 hr each)	Topic
1	1	Physical quantities, vectors and motion in 2D - projectile
	2	Newton's laws of motion I - relative motion - reference frame - Newton's Three Laws
	3	Newton's laws of motion II - Friction - circular motion
	4	Work and kinetic energy - Work-energy theorem - Work done by a varying force
	5	Potential energy and energy conservation - Gravitational (mgh) and elastic PE - Conservative and non-conservative forces
	6	Momentum, impulse and collision I - Impulse-momentum theorem - Conservation of momentum - Elastic, inelastic, and completely elastic collision
2	7	Momentum, impulse and collision II - Elastic collision - Center of mass
	8	Dynamics of rigid bodies I - Angular displacement, velocity and acceleration - Rotational kinetic energy and moment of inertia
	9	Dynamics of rigid bodies II - Calculation of moment of inertia - Torque
	10	Dynamics of rigid bodies III - Rigid body rotation about a moving axis - Work and power in rotation motion
	11	Angular momentum - Conservation of angular momentum - Gyroscope (excluding calculation of precession speed)
	12	Gravitation I - Newton's law of gravitation - Gravitational force and potential energy - Satellite motion
3	13	Gravitation II - Kepler's laws of planetary motion - Spherical mass distribution - Apparent weight due to earth's rotation - Black hole
	14	Periodic motion I - Simple harmonic motion
	15	Periodic motion II - Various types of SHM, pendulum - Damped and forced oscillations

		- Resonance
	16	Wave motion and sound I - Mathematical description of wave - Power propagation - Reflection of travelling waves
	17	Wave motion and sound II - Standing wave - Beat - Doppler effect
	18	Temperature and heat - Thermal expansion - Heat capacity and latent heat - Heat transfer
4	19	Thermal properties of matter I - Equation of state - Kinetic theory of ideal gas
	20	Thermal properties of matter II - Heat capacity of gases - Molecular speed distribution
	21	First law of thermodynamics I - Heat and work in thermodynamic processes
	22	First law of thermodynamics II - Typical thermodynamic processes - Heat capacities of ideal gas under different conditions - Adiabatic process of ideal gas
	23	Second law of thermodynamics I - heat engines and refrigerators - different forms of the second law
	24	Second law of thermodynamics II - reversible processes - Carnot cycle and engine

PHYS 1113 GENERAL PHYSICS I LABORATORY
SUMMER 2018

(4 weeks; Tentative dates: 19 Jun – 13 Jul 2018)

A. Course Description

PHYS 1113 is the laboratory course to accompany PHYS 1112. Experiments in mechanics and heat are chosen to illustrate the experimental foundations of physics presented in the lecture course.

Credit Points: 1
Pre-requisite: None
Co-requisite: PHYS1112

B. Intended Learning Outcomes (ILO)

On successful completion of this course, students are expected to be able to:

1. Conduct experimental investigations of simple mechanical and heat phenomena
2. Carry out measurements with proper techniques and safety practices.
3. Build and practice teamwork skills through group projects.
4. Practice record keeping of experimental work and data graphing.
5. Analyze data using simple statistics and compare the results with theory.

C. Student Learning Resource

General Physics I Lab Manual, by Penger Tong and David Mak

D. Teaching and Learning Activities

on average 5 hours of lab per week (total 4 weeks)

E. Assessment

	Lab performance	Lab report
Weighting	30% Assesses Course ILO 1,2,3	70% Assesses Course ILO 4,5

F. List of Experiments

M1: The Atwood Machine
M2: Projectile motion
M3: Centripetal force
M4: Work, energy and friction
M5: Conservation of linear momentum
M6: Rotational motion
M7: Conservation of angular momentum
M8: Simple harmonic motion
M9: Standing waves on a vibrating string
H1: Specific heat and latent heat of vaporization

PHYS 1114 GENERAL PHYSICS II
SUMMER 2018

(4 weeks; Tentative dates: 16 Jul – 13 Aug 2018)

A. Course Description

PHYS 1114 employs a calculus-based approach. Key topics include:

- Electric charge and field
- Gauss' Law
- Electric potential
- Capacitance and dielectrics
- Current, resistance, EMF
- Direct-current circuits
- Magnetic field and magnetic forces
- Sources of magnetic field
- Electromagnetic induction
- Inductance
- Alternating current
- Electromagnetic waves
- The nature and propagation of light
- Interference
- diffraction

Credit Points: 3
Pre-requisite: PHYS 1112 and Senior high school level or above in math with single-variable calculus

B. Intended Learning Outcomes (ILO)

On successful completion of this course, students are expected to be able to:

1. Classify the nature of electric and magnetic fields, which occur in numerous applications in industry and technology, as well as in everyday life
2. Describe visible light as part of the electromagnetic wave spectrum
3. Apply the wave nature of light to describe natural phenomena
4. Perform simple calculations by applying the basic concepts of electromagnetism and optics
5. Use scientific language to explain phenomena in the physical world
6. Use calculus to analyze and solve physical problems

C. Textbook

Textbook: University Physics by Young & Freedman
Online assignment system: Mastering Physics http://masteringphysics.com
Experimental demonstrations: http://teaching.phys.ust.hk/demo

D. Teaching and Learning Activities (total 4 weeks)

	Lecture	Tutorial	Independent study
Hours per week	9	6	12

E. Assessment

	Online assignment	Tests	Final exam
Weighting	10%	40%	50%

G. Course Schedule

Week	Lecture (1.5 hr each)	Topic
5	1	Electric charge and electric field I - Electric charge in real life - Electric force between point charges (Coulomb's law) - Electric field due to a point charge
	2	Electric charge and electric field II - To visualize electric field using electric field lines. - To use the principle of superposition to calculate electric fields due to some standard charge distributions. - The torque and potential energy of an electric dipole in a uniform electric field.
	3	Gauss' Law I - The meaning of electric flux. - Gauss's law. - Distribution of excess charge in a conductor.
	4	Gauss' Law II - Electrostatic shield and the Faraday cage. - To use Gauss's law to calculate electric field due to symmetric charge distributions.
	5	Electric potential I - Electric force as a conservative force - Electric potential energy as a property of the field and test charge - How electric potential energy of a charge changes when moving in an electric field - Electric potential as a property of the field only, independent of the test charge - To calculate the electric potential of a system
	6	Electric potential II - Calculate potential through the field and Gauss's law - Calculate potential by breaking up a charge distribution into sum of point charges - Equipotential surfaces and their implications on conductors - Calculate the field from the potential
6	7	Capacitance and dielectrics I - A capacitor as a charge reservoir - To calculate the capacitance of conductors with different geometric arrangement - To calculate networks of capacitors - A capacitor as an energy reservoir - Electric potential energy interpreted as energy stored in an electric field
	8	Capacitance and dielectrics II - The effect of dielectric on capacitance - The molecular model for induced charge on dielectric - Gauss's law in a dielectric medium
	9	Current, resistance and EMF - Microscopic view of current in a conductor, current density and drift velocity - Ohm's law, ohmic and non-ohmic materials

		- Resistivity and resistance, and their variation with temperature - Electromotive force as a mean to drive a constant current - Power delivery and dissipation in a direct current circuit
	10	Direct-current circuits - Kirchhoff's rules to deal with complex circuits - Charging, discharging, power delivery and dissipation in an R-C circuit
	11	Magnetic field and magnetic forces I - Definition of magnetic field - Visualizing magnetic field using magnetic field lines - Magnetic flux and the Gauss's law in magnetism - Examples of charged particle motion in magnetic field
	12	Magnetic field and magnetic forces II - Lorentz force and devices that make use of it. - Force of a current carrying conductor in a magnetic field in vector form. - Turning effect of a current loop in a uniform magnetic field in vector form. - Magnetic moment as current loop or bar magnet, and effect in a nonuniform magnetic field - The Hall effect
7	13	Sources of magnetic field I - Magnetic field due to a moving charge - Magnetic field due to a current, the Biot-Savart law - To define ampere in turns of the force between two long current-carrying wires - Magnetic field due to a current-carrying coil
	14	Sources of magnetic field II - Ampere's law and how to use it to find magnetic field due to symmetric current distributions - Magnetic materials, how to distinguish among paramagnetism, diamagnetism, and ferromagnetism
	15	Electromagnetic induction I - Faraday's law of induction to calculate the induced emf - Lenz's law to determine the direction of magnetic induction effect - Simple generators and motor
	16	Electromagnetic induction II - The nature of induced emf, motional and non-motional. - The nature of induced, non-electrostatic electric field. - To generalize the Ampere's law to discontinuous currents by introducing displacement current. - The Maxwell's equations as a summary of electromagnetism
	17	Inductance - Self-induction and inductors - Building up of magnetic flux in an inductor, analogous to building up charge in a capacitor - Oscillation in an L-C circuit, analogous to a spring-mass system (simple harmonic oscillator) - R-L-C circuit, analogous to a damped harmonic oscillator

	18	Alternating current - To use phasor diagrams to analyze ac circuits - The response of resistor, inductor and capacitor in an ac circuit - Power delivery and resonance in an L-R-C circuit
8	19	Electromagnetic waves - The nature of an electromagnetic wave as oscillating electric and magnetic fields - The speed of an electromagnetic wave in vacuum in terms of ϵ_0 and μ_0 - Standing electromagnetic wave
	20	The nature and propagation of light - Light as a traverse wave - Dispersion of visible light and the formation of rainbow - Polarization of light, linear, circular, and elliptical - Scattering of light and commonly observed phenomena in the atmosphere
	21	Interference I - Constructive and destructive interference of light - Young's double slit interference pattern - Power transfer in an interference pattern
	22	Interference II - Interference pattern due to thin films - Applications of interference as in Newton's rings and non-reflective coating - Interference as a way by which nature produces sharp colors - Principles of the Michelson interferometer - The Michelson-Morley experiment and its significance
	23	Diffraction I - Diffraction pattern from a single slit – Fraunhofer diffraction - Huygens's principle in wave optics - Intensity in a single slit diffraction pattern - Intensity in the Young's double slit interference pattern
	24	Diffraction II - Diffraction pattern from multiple slits and its intensity distribution - Diffraction grating and grating spectroscopy, chromatic resolving power - Diffraction pattern from a circular aperture, angular resolving power of optical instruments

PHYS 1115 GENERAL PHYSICS II LABORATORY
SUMMER 2018

(4 weeks; Tentative dates: 16 Jul – 13 Aug 2018)

A. Course Description

PHYS 1115 is the laboratory course to accompany PHYS 1114. Experiments in static and current electricity and magnetism, and optics are chosen to illustrate the experimental foundations of physics presented in the lecture course.

Credit Points: 1
Pre-requisite: None
Co-requisite: PHYS1114

B. Intended Learning Outcomes (ILO)

On successful completion of this course, students are expected to be able to:

1. Conduct experimental investigations of simple electric, magnetic and optical phenomena discussed in the lab manual.
2. Carry out measurements with proper techniques and safety practices.
3. Build and practice teamwork skills through group projects.
4. Practice record keeping of experimental work and data graphing.
5. Analyze data using simple statistics and compare the results with theory.
6. Write summaries to explain the theoretical background and major experimental achievements and findings.

C. Student Learning Resource

General Physics I Lab Manual, by Penger Tong and David Mak

D. Teaching and Learning Activities

on average 5 hours of lab per week (total 4 weeks)

E. Assessment

	Lab performance	Lab report
Weighting	30% Assesses Course ILO 1,2,3	70% Assesses Course ILO 4,5,6

F. List of Experiments

EM1: Coulomb's Law
EM2: Capacitance and electrostatic energy
EM3: Coulomb Constant
EM4: DC circuits
EM5: Magnetic field generated by a coil
EM6: The current balance
EM7: Introduction to the oscilloscope
EM8: Faraday's Law of induction
EM9: AC circuits
O1: Two-slit interference and diffraction grating